

Jet Structure: Status and Plans

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sPHENIX Jet Structure Topical Group Meeting

Outline

- Regular bi-weekly meeting times, Tuesdays at 11am
- In this meeting:
 1. Summary of ALD Charge activities
 2. Plans for future Jet Structure activities
 - ➔ sample list of tasks & interested people
 3. Discussion about upcoming Tracking Review
- In next meetings, will start asking for contributions
 - ➔ in particular, will arrange talk by CMS HI expert on Particle Flow advantages in Pb+Pb collisions

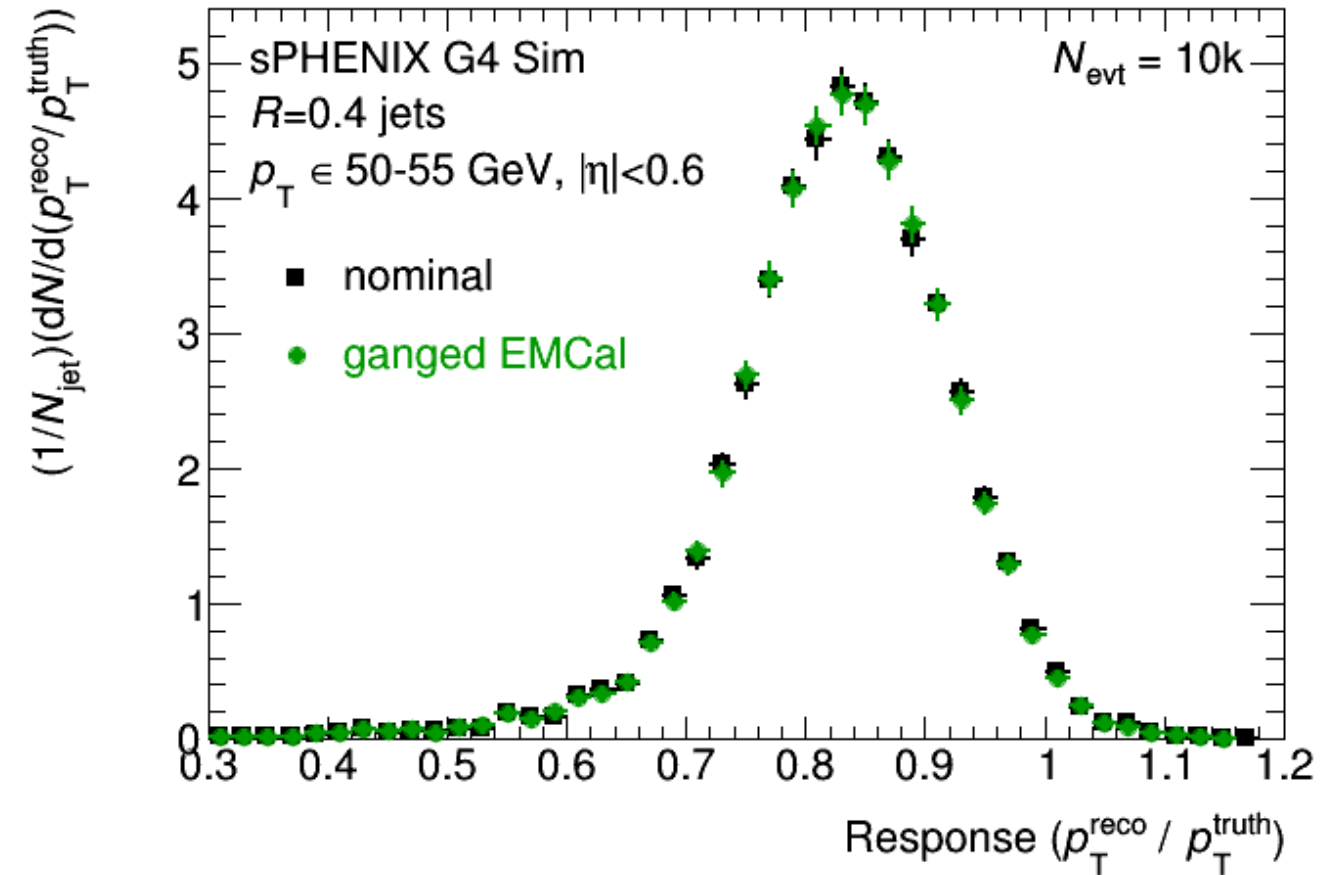
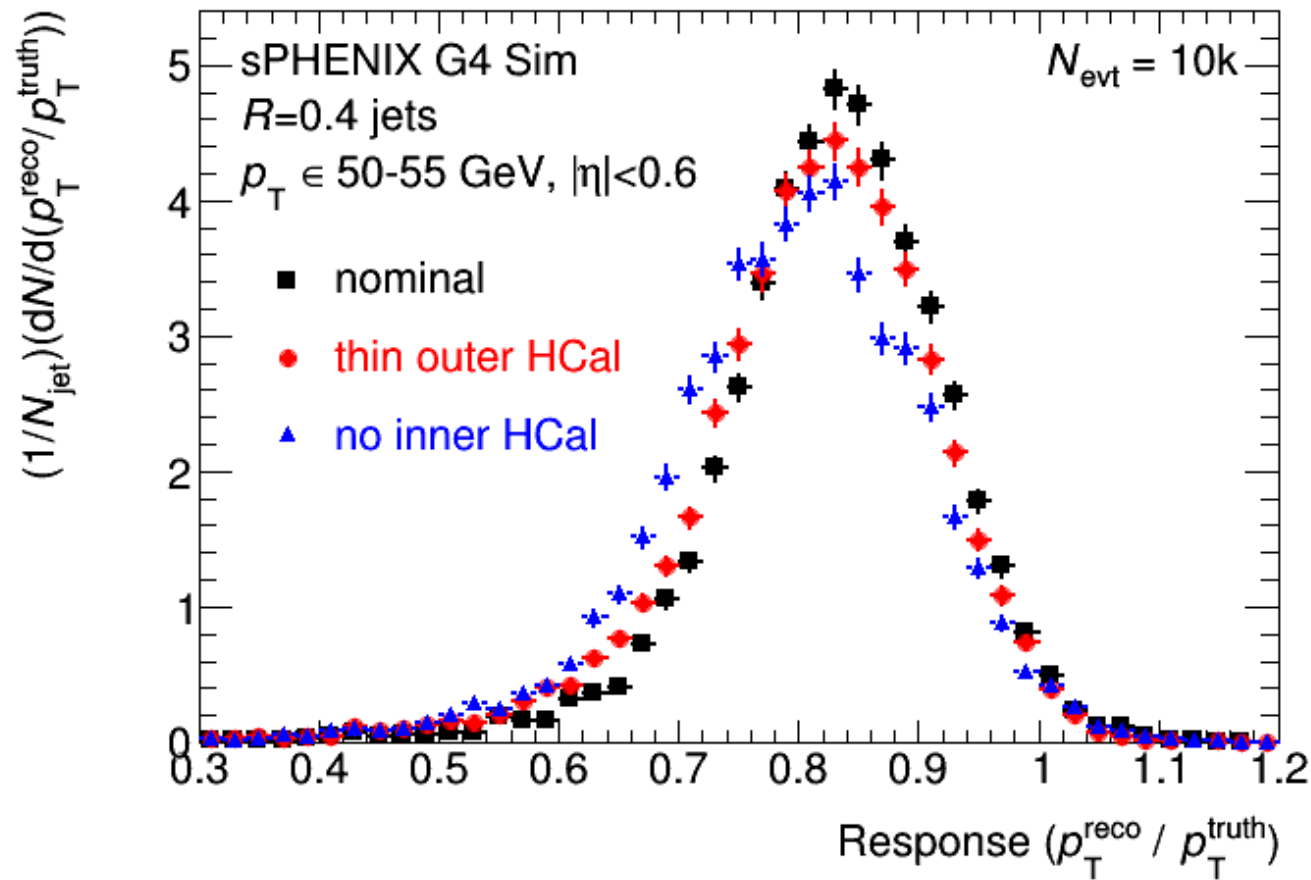
1. Response to ALD charge

- Spent April and May planning and executing response to ALD Charge
 - ➔ in meetings, over mailing list, in person at sPHENIX Collab. Mtg.
 - ➔ https://www.dropbox.com/s/qnlhe3uulw647yp/sPHENIX_scope_cost_060616.pdf?dl=0
- Original intention was to proceed along two fronts:
 1. evaluate jet performance under different calo configurations
 - ➔ jet response, statistics for fully-contained jets, biases on measurements, etc.
 - ➔ spent most of our effort here
 2. evaluate high- p_T tracking performance inside jets
 - ➔ efficiency, resolution, fake rates
 - ➔ unfortunately, due to real-time developments in tracking simulations and software, this effort didn't mature

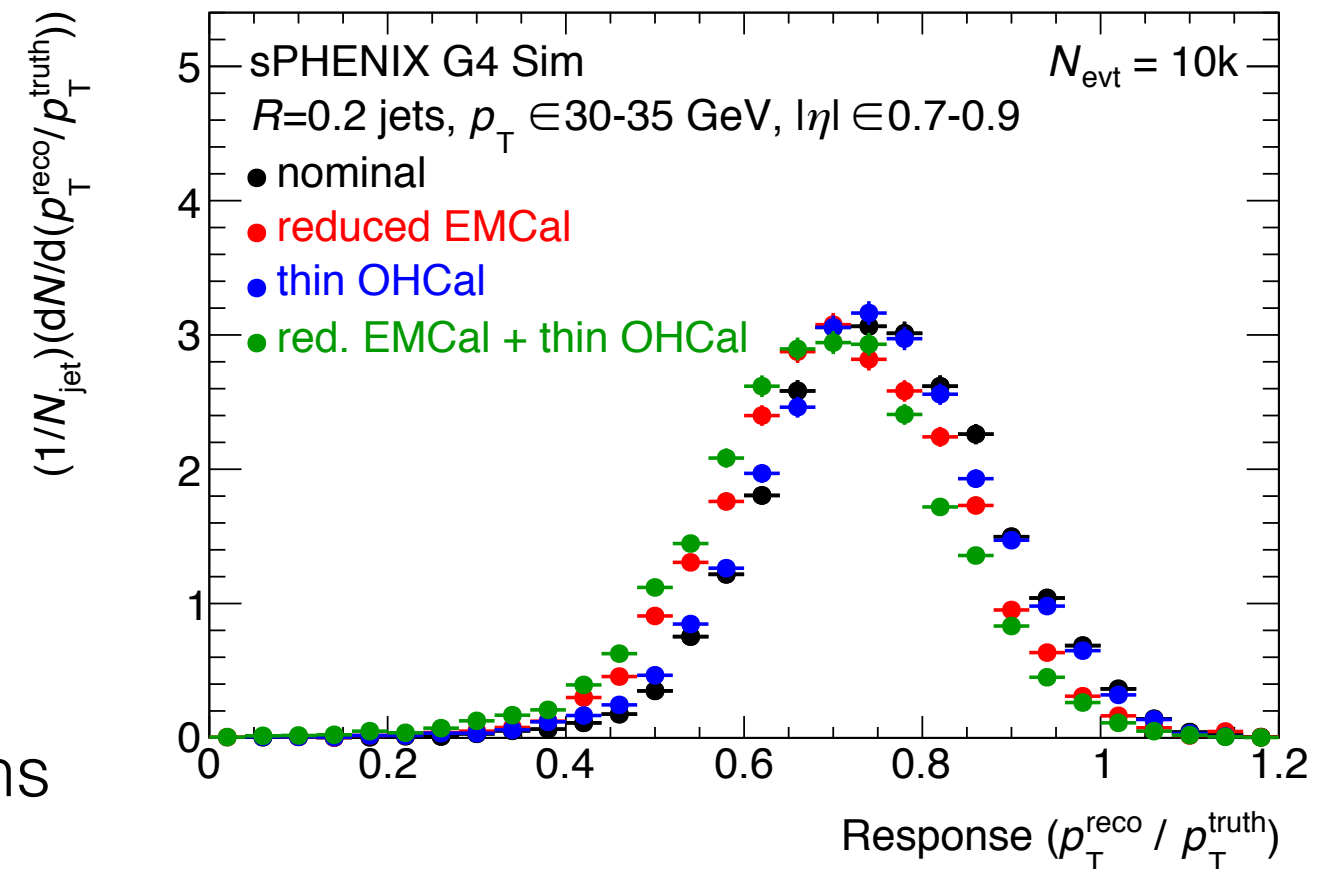
1. MC samples

- To perform these studies, we used a common set of MC events
 - ➔ with a well-defined generator-level selection
 - ➔ which were then simulated with Geant4 under specific, documented detector configurations
- HepMC Pythia8 dijet events at /direct/phenix+upgrades/decadal/dvp/GeneratorInputFiles (kinematics chosen according to need):
 - ➔ $R=0.4$, $p_T=50-55$ GeV, $|\eta|<0.6$
 - ➔ $R=0.4$, $p_T=60-65$ GeV, $|\eta|<0.6$
 - ➔ $R=0.2$, $p_T=25-30$ GeV, $|\eta|<0.9$
 - ➔ $R=0.2$, $p_T=30-35$ GeV, $0.7<|\eta|<0.9$
- G4 Hits files prepared by Chris Pinkenburg, at /sphenix/sim/sim01/production/aldcharge/pythia8/pythia8dijet
 - ➔ for example: in R0p2pT30to35eta0p7to0p9, you will see: *spacal1*, *hcalout_thin*, *cemcreduced*, *cemcreduced_hcalout_thin*

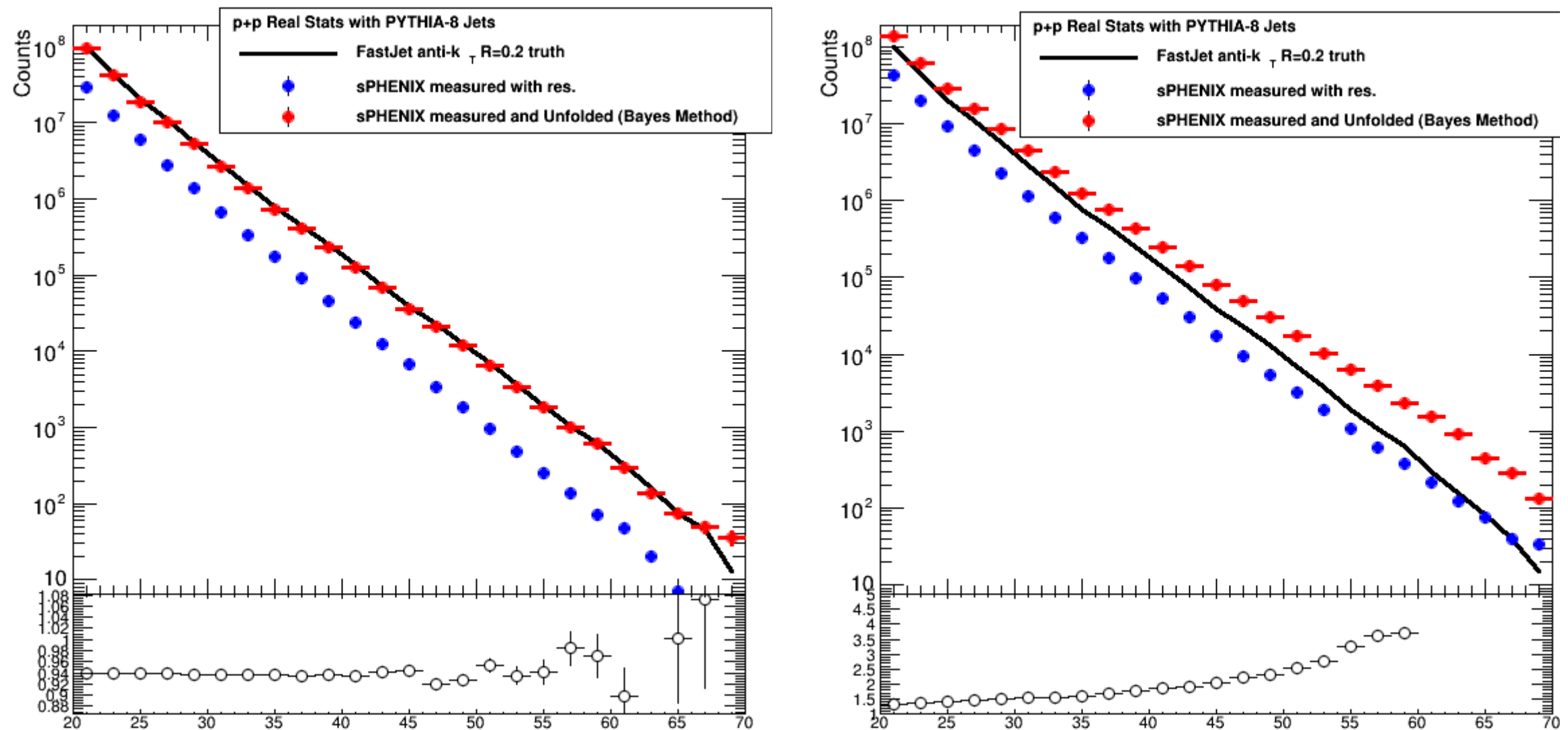
1. Jet response studies



- Examining effect of different calo stack configurations
- ➔ Upper left: HCal configurations for large- R , high- p_T jets
- ➔ Upper right: ganged EMCAL
- ➔ Lower right: HCal x EMCAL configurations for small- R , large- η , low- p_T jets



1. Effects on unfolded measurements

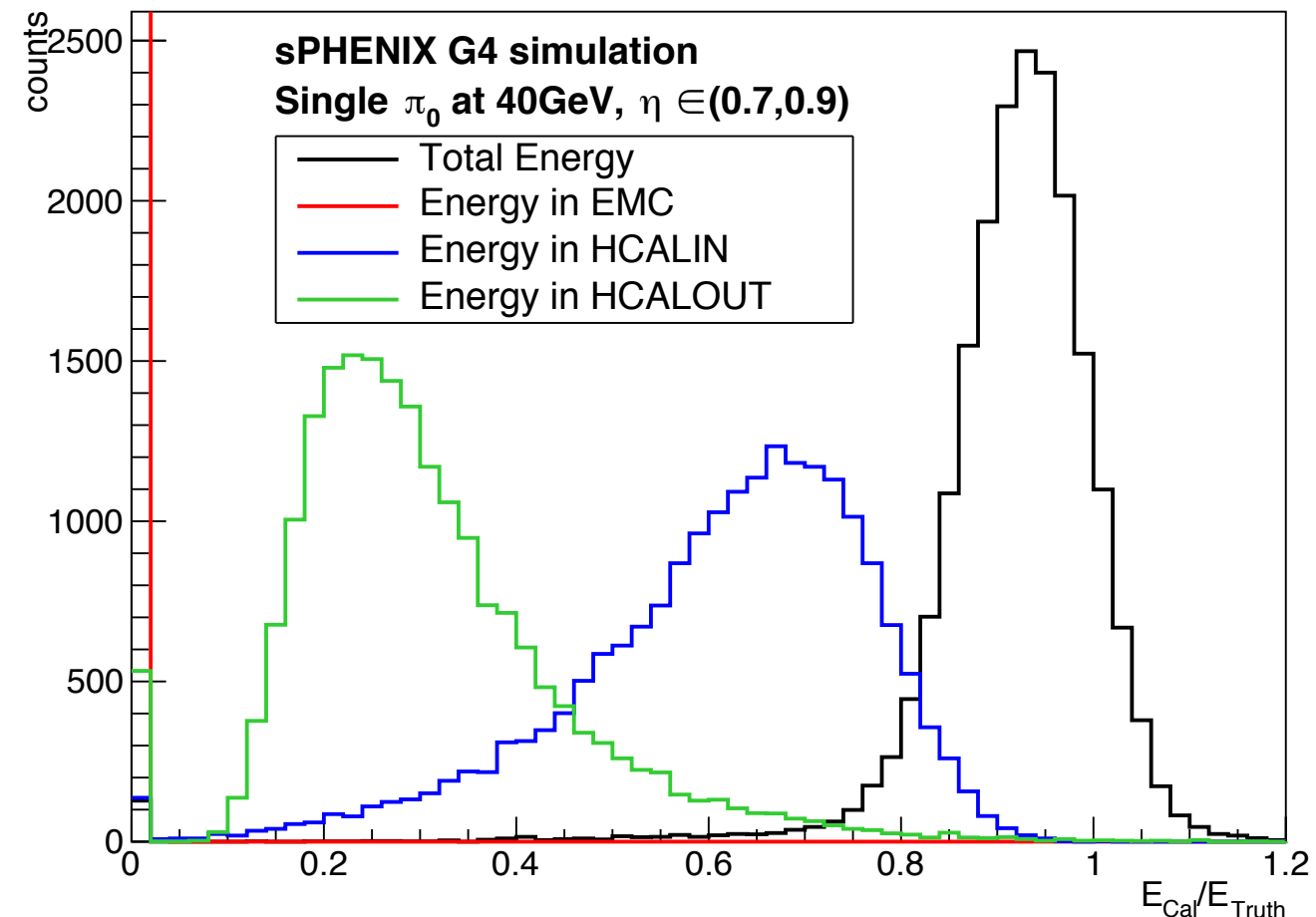
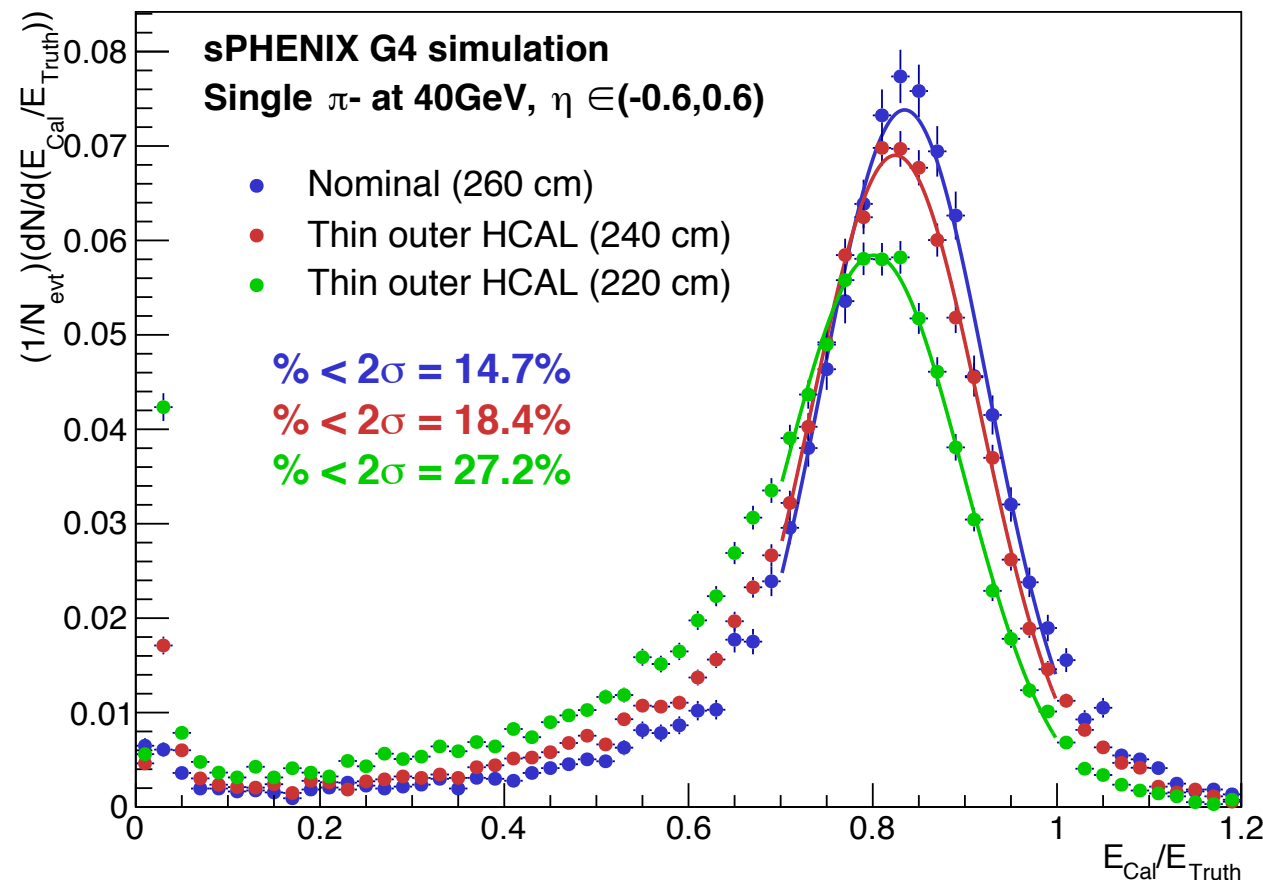


- Toy unfolding studies by Jamie Nagle of how mis-estimating response affects results (note: scenarios not necessarily equally likely)
- Left: missing a *low-side tail* causes overall E-scale shift
- Right: missing *high-side tail* has dramatic effects

1. Hadron response studies

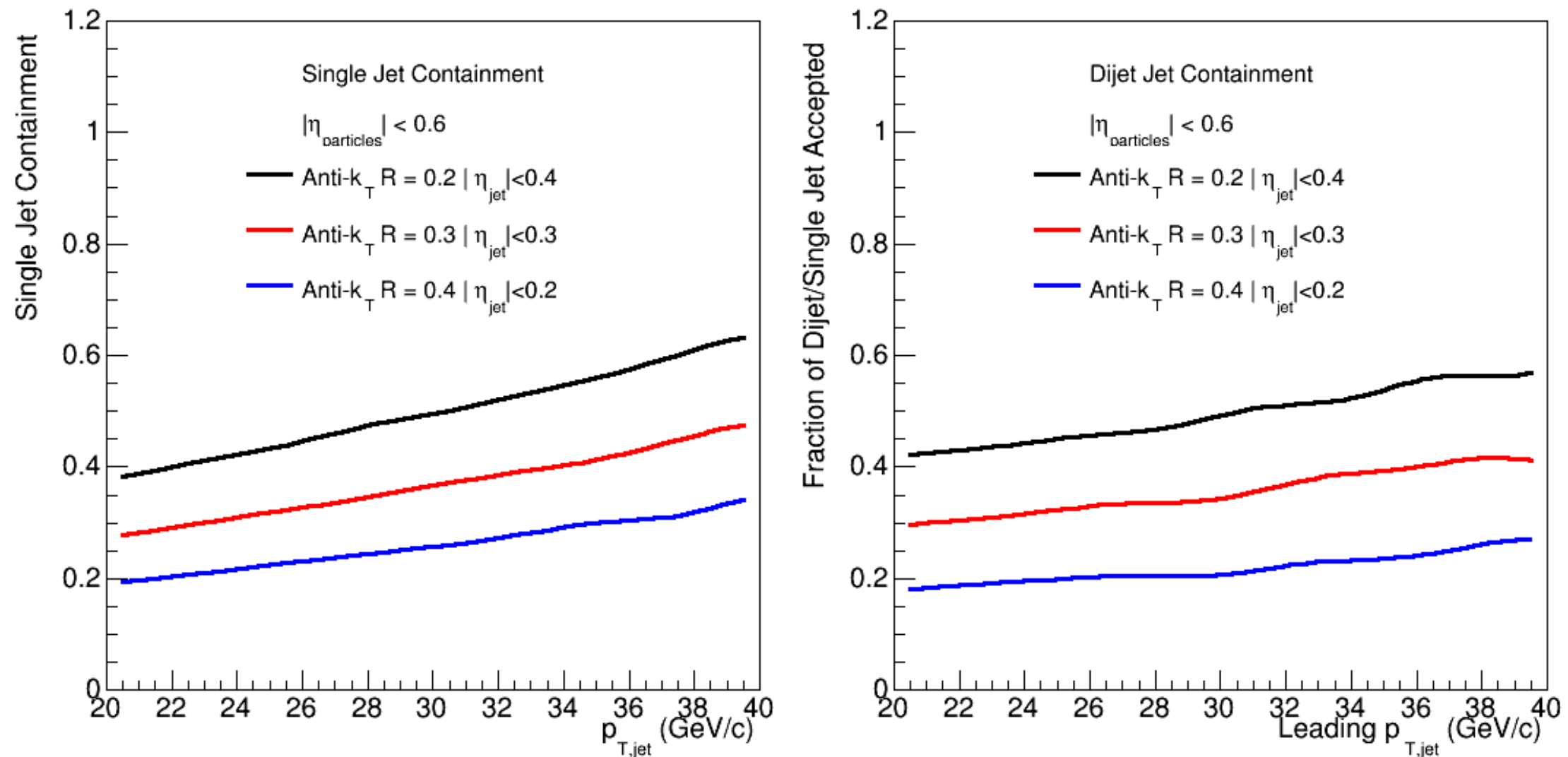
Misses EMC: $\eta = (0.7, 0.9)$

Total Calorimeter Response (Cluster)



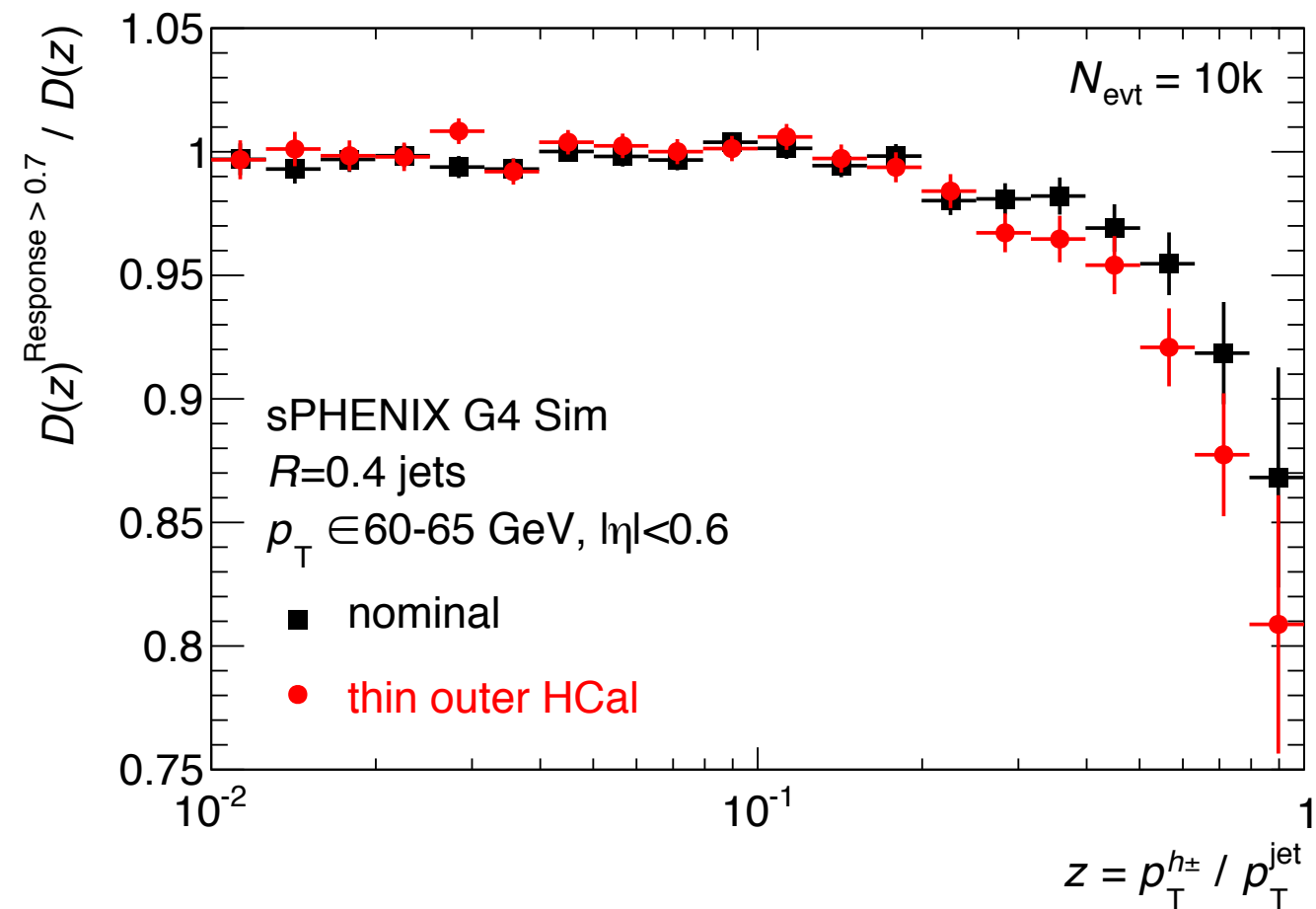
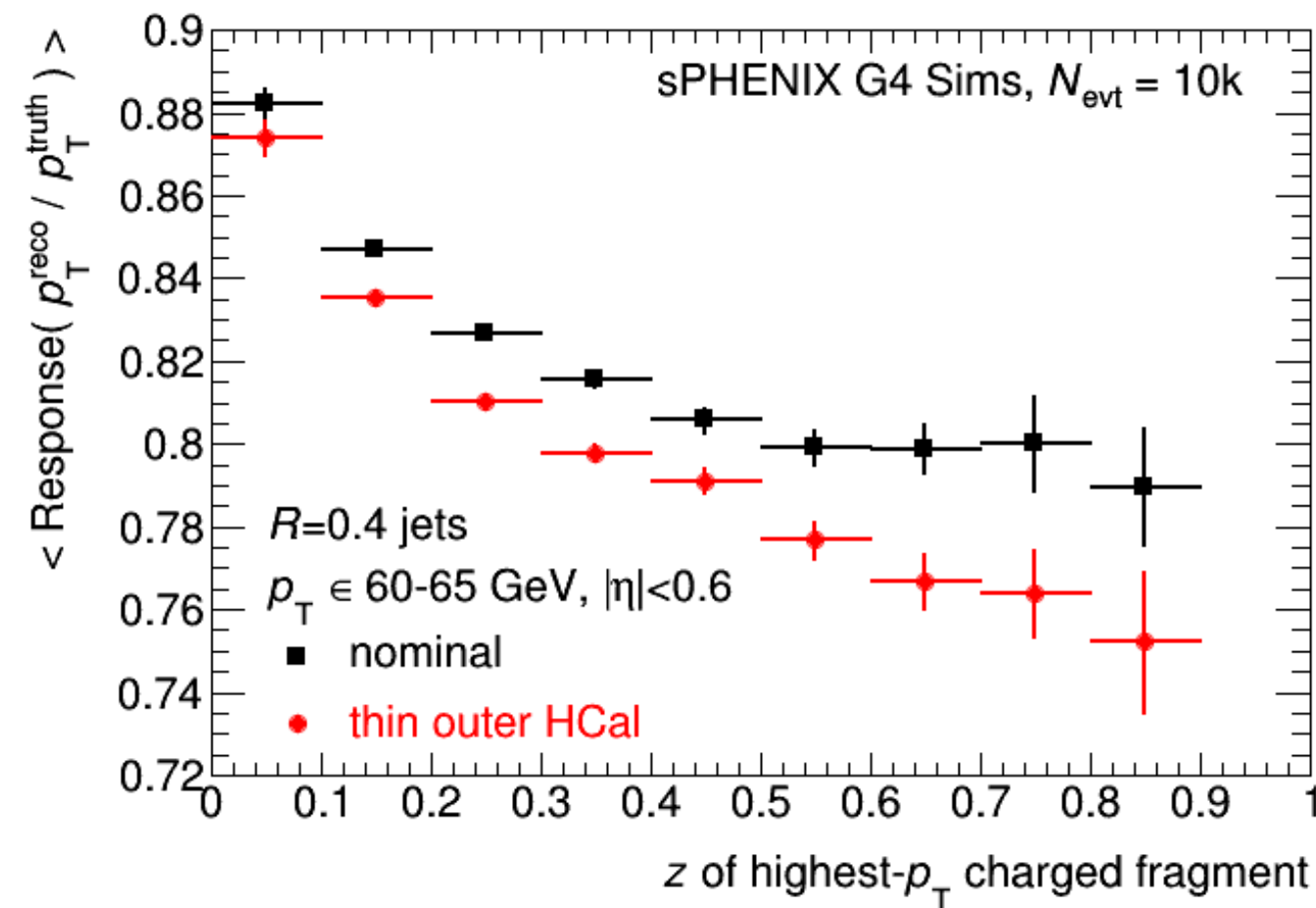
- Single hadron response studies by Kurt Hill
- Left: with thin OHCAL, rate of punch through hadrons increases
- Right: with reduced- η EMCAL, EM energy ends up in the I + OHCAL

1. Jet containment studies



- Jet / dijet containment in reduced acceptance by Rosi Reed
 - ➔ if all jets required to be fully contained in $|\eta| < 0.6$, what is the fraction of jets (left) and dijets (right) satisfying this requirement

1. Biases on FF measurements



- How strong is the correlation between fragmentation pattern (e.g. max- z_{charged}) and response?
- Left: with thinner OHCAL, stronger dependence of $\langle \text{Response} \rangle$ on z
- Right: with thinner OHCAL, modestly larger bias on FF if one requires reasonably high Response
 - ➔ also useful discussion threads with Megan, John L, Aaron, many others

2. Future activities

- Activities for ALD Charge were immediate-timescale and to-the-point
- Jet Structure group should transition to work towards longer term payoff:
 1. develop reconstruction/analysis infrastructure in software
 2. benchmark detector performance with latest simulations & software updates
- On next several slides, some suggested topics are given
 - ➔ volunteers or expressions of interest welcome
 - ➔ no prior “claim” is needed, names are just placeholders from previous meetings / conversations

Topics (1/4)

- Photon identification & performance
 - ➔ status: essentially no work at any point within sPHENIX development
 - ➔ example task(s): develop shower shape cuts for γ/π^0 separation at low- p_T , isolation on top of Au+Au underlying event
 - ➔ interested people: Justin Frantz + Ohio U group?
- Develop calorimeter clustering in Au+Au
 - ➔ status: very simple geometric clustering procedure for $p+p$ collisions
 - ➔ example tasks(s): implement modern clustering algorithms, create capability to run cluster on UE-subtracted towers
 - ➔ interested people: Brandon McKinzie + MIT group?

Topics (2/4)

- Systematic studies of jet response
 - ➔ status: MIE showed some selected results
 - ➔ example task(s): test that UE subtraction still works, response/JES/JER differentially in jet p_T / η / R / centrality
 - ➔ interested people: n/a
- Track-cluster matching
 - ➔ status: past work showed some track purity could be regained at loss of efficiency
 - ➔ example tasks(s): continue studies, include latest tracking configuration & developments in clustering
 - ➔ interested people: Ron Belmont, Kurt Hill + Colorado group?

Topics (3/4)

- STAR/ALICE-style “recoil jet + event mixing” capability
 - ➔ status: previous work has focused more on “ATLAS-style” explicit fake jet rejection
 - ➔ example task(s): feasibility studies, basic $p_T^{\text{reco}} - A \times \rho$ distributions for jets opposite high- p_T track trigger, event mixing
 - ➔ interested people: n/a
- Particle Flow jet reconstruction
 - ➔ status: previous work by Javier Orjuela-Koop & Colorado group showed only modest improvement over calo-based jet finding
 - ➔ example tasks(s): reboot with latest detector configuration / clustering tools & expertise from CMS?
 - ➔ interested people: Rosi Reed + Lehigh group?

Topics (4/4)

Many other important tasks open for contributions:

- Flavor-dependence of jet performance
 - ➔ evaluate separately for g vs. $u/s/d$ vs. c vs. b
- Fake jet rejection via track, track-jet or cluster matching
 - ➔ using latest tracking configuration & clustering
- Blind unfolding tests of modified jet spectra
- Response to quenched jets
 - ➔ interface JEWEL/PyQuen/QPythia with event generators and see if response is different
- ... etc.

Tracking Review

- BNL-charged review of tracking options, 7-9 September
 - ➔ working to understand scope, timescales, deliverables, etc.
- Jet Structure group should contribute with studies of tracking-related performance relevant to our physics scope
 - ➔ need to coordinate with Simulations group and Upsilon TG (where tracking performance is studied more generally)
 - ➔ plan to repeat common-use MC sample model
- In my opinion, most direct studies are likely to be:
 - ➔ tracking performance at high- p_T in jets for FF measurements (where jet cone limits fake rate)
 - ➔ tracking performance at all- p_T for missing- p_T or charged hadron spectra (possibly with calo-matching)

Outlook

- First of our regular bi-weekly meeting times, Tuesdays at 11am
 - ➔ In next meetings, will start asking for contributions
- 1. Summary of ALD Charge activities
- 2. Discussed plans for future Jet Structure activities
 - ➔ volunteers welcome — no prior experience or involvement necessary
- 3. Should begin thinking about upcoming Tracking Review in early September